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EXPERIMENTAL STRUCTURAL BEHAVIOR OF SCAFFOLDING PLASTIC ANCHORS IN REAL BRICK MASONRY WALLS

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1. Introduction – The anchors behavior to pull-out tests in different types of wall samples have been analyzed in many studies [1,5]. However, fewer are the researches performed on real brick masonry walls. Masonry walls constitute a system that can comprise a great number of materials, and therefore, their behavior is influenced by different parameters such as the type of the fastener, the type of brick, the drilling system or the holes of the anchoring configuration. This study analyzes the behavior of anchors placed in real perforated masonry brick walls.

The fracture load and the displacement values of anchorages in different embedment lengths and placement positions have been determined (Figure 1). This on-site obtained data has allowed us to assess how various parameters in anchor settings could affect the load bearing capacity of the fasteners used in scaffolding and brickwork systems [6,7].

Figure 1 Pull-out test

2. Methods – Requirements and assessment and test methods for this fixing types are set out in the Guideline for European Technical Approval of Plastic Anchors for Multiple Use in Concrete and Masonry for non-structural applications (ETAG-020, 2012) [8]. The document has been drawn up by the experts committee of the European Organization for Technical Approval (EOTA). The Part 4 of the document sets out the verification methods, as well as the assessment methods of the fastening systems for their use.

The present research work collects the results obtained in the different tests carried out in accordance with the methodology described in the regulations. The aim was to have a starting point on the pull-out strength of steel eye-bolt anchors sleeved in plastic plugs and introduced at different depths in real masonry perforated brick walls. The experimental study was done in the center of the piece, so that, firstly external finishing was removed. For the pull-out strength study, series of pull-out tests have been performed at different depths and location of the anchor, both inside the wall unit or in the pointing.

Extractions of anchors have been designed and tested using a Hilti tool, HAT 28 M. The equipment consists of mechanical screw acting on a hydraulic load cell. It measures the load applied directly on the anchor, showing it in a manometer. A ruler allows controlling the value of the displacement of the eyebolt during the test

3. Results and Discussion – In this study, series of at fifteen tests using steel eye bolts of 120 mm total anchor length; with 70 mm threaded shank and 50 mm unthreaded shank have been performed. The plugs introduced in the interior of the selected piece of the wall are 70 mm in length and 14 in diameter, and were flush with the outside wall face. The introduction of the eyebolt in the plug is done by rotation. In the tests, the maximum load and the displacement corresponding to that load value have been obtained as a result.

In the first study (Table 1), the influence of the eye-bolt length introduced in the masonry wall was studied. Therefore, in a first series (Series 1), the steel eye-bolt was introduced up to its head, both inlaying the threaded and the unthreaded area of the shank. In the second test series (Series 2) only the threaded part was inserted in the plug

Partial embedment	Load (kN)	Displacement (mm)	Total embedment	Load (kN)	Displacement (mm)
1.1	5	1.25	1.2	5	1
2.1	4.5	0	2.2	5.5	1
3.1	4	1	3.2	8	1.75
4.1	5	1	4.2	9	1,4
5.1	5	1	5.2	4.5	0.87
6.1	5	0	6.2	4.5	1
7.1	2	0	7.2	6.5	2
8.1	2	0	8.2	4	1
9.1	2	0	9.2	6	1
10.1	5	0	10.2	6	1
11.1	4.5	0.75	11.2	5.5	1
12.1	7	0	12.2	6	0.75
13.1	6	1.75	13.2	6	0.75
14.1	7	1.25	14.2	5.5	1.25
15.1	5	2	15.2	6	1
mean	4.6	0.7	mean	5.9	1.10

Table 1 Maximum pull-out load and displacement

4. Conclusions – The maximum load reached by an eye-bolt anchor placed inside of a plastic plug in a real brick masonry wall is significantly higher if the eyebolt is introduced only on its threaded area and not when the totality of the shank is used (table 1). The results offer a mean fracture load value of 5.9 kN when only the insertion is only in the threaded part. In contrast, 4.6 kN when the eyebolt is fully inserted. Also, in the first case, the displacement produced is greater, indicating a greater ductility of the anchor. It is important to highlight that the results of both tests performed in real brick masonry walls [3] show significantly higher values to those obtained in tests carried out in brick samples and published in experimental studies. Data provided in this article have offered real values, which imply an advantage in the safety improvement of the installation of auxiliary means or collective protections in facades, work platforms or scaffolding systems.

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